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Evaluation of agrarian sustainability in Bulgaria

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Abstract. This article presents a holistic approach for assessing agrarian sustainability in Bulgaria based on its economic, social and ecological aspects on sectoral macro-level. It is based on official statistical and other information as well as on expert evaluation. Our study has found that the Bulgarian agriculture on macro-level has *good* sustainability. Some of the sustainability aspects have higher levels such as the economic aspect, while others like social and environmental aspects are inferior. Study results could help in focusing the political efforts, so that the agrarian sustainability, in its social and ecological aspect, could be increased. However, a further research is needed to evaluate the level of sustainability at micro-level, so that the major issues and problem areas are addressed accordingly.
Keywords. Agrarian sustainability, Sustainability indicators, Ecological aspects, Bulgarian agriculture.
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1. Introduction

In the world literature, the question of assessing agrarian sustainability is among the most discussed by scientists, policy makers, farmers and stakeholders (Andreoli & Tellarini, 2000; Bachev, 2005; Bastianoni *et al.,* 2001; FAO, 2013; Häni *et al.,* 2006; Sauvenier *et al.,* 2005; OECD, 2001). The agrarian sustainability has usually been assessed at national or international level (FAO, 2013; OECD, 2001) and usually it is described as ability to satisfy a diverse set of goals through time (Brklacich *et al.,* 1991; Hansen, 1996) or the ability to maintain or improve its functions (Lopez-Ridaura *et al.,* 2002). Often the term sustainability is wrongly associated only with preserving the environment and productivity of the agricultural resources but in our research we consider that agriculture is sustainable if it could maintain its economic, ecological and social functions in a long-term (Bachev, 2010; Bachev *et al.,* 2016).

There is a substantial literature dedicated to analyzing the different aspects of sustainability - economic, social and/or ecological. Thesethree aspects are related to multiple functions of modern agriculture, they are equally important and have to be always accounted for. Agriculture is sustainable if it is: economically viable and efficient; socially responsible regarding farmers, workers, other agents,

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communities, consumers and society; andecologically sustainable (Bachev *et al.,* 2016).

The agrarian sustainability is a topic of great interest in Bulgaria, as well, and it has been subject of studies, mainly focusing on the sustainability of the agrarian holdings and/or specific activities or sectors (Bachev, 2016; Bachev *et al.,* 2016). However, this is the first attempt to make a comprehensive assessment of the sustainability of the Bulgarian agriculture on a sectoral macro-level embracing its three aspects. This article presents a holistic approach for assessing agrarian sustainability based on its economic, social and ecological aspects on sectoral macro-level. It is based on official statistical and other information as well as on expert evaluation.*Its aim* is to estimate the sustainability index for each one of the tree main aspects and to identify the critical areas that lead to improving the level of agrarian sustainability in Bulgaria.

2. Definition, materials and methods

In the literature and managerial practice there are diverse approaches for defining agrarian sustainability -as an *alternative ideology* (Edwards *et al.,* 1990; VanLoon *et al.,* 2005); as a *new (set* of) strategy/ies (Mirovitskaya & Ascher, 2001); as a characteristics of agrarian systems – e.g. "ability to satisfy a diverse set of goals through time" (Brklacich *et al.,* 1991, Hansen, 1996), "ability (potential) of the system to maintain or improve its functions" (Lopez-Ridaura *et al.*, 2002; Lewandowski *et al.,* 1999); as a "process of learning about changes and adapting to these changes" (Raman, 2006), etc.

Definition of agrarian sustainability has to be based on the "literal" meaning of that term and perceived as a system characteristics and "ability to continue through time" (Bachev, 2010). It is a feature of agricultural activity – production associated with cultivation of animals, plants, fungi, and other life forms for human and livestock food, raw materials for processing industries, bioenergy, medicinal and other products and services. Its important feature is the management and utilization of agro-ecosystems of different type (plain, mountainous, riverside, seaside, open-air, closed, etc.), and the "responsibility" for their preservation for future generations.

The characterization of sustainability has to be "system-oriented" while the system is to be clearly specified, including its time and spatial boundaries, components, functions, goals, and importance in the hierarchy. That implies taking into account the diverse socio-economic and environment conservation functions of agrarian sector, the type and efficiency of agrarian organization, and the mutual links (importance, dependency, complementarity) of different governance and organizational structures, and relations with sustainability of households, region, eco-system and the entire sector (industry).

Sustainability has to reflect both the internal capability of agriculture to function and adapt as well as the external impact of constantly evolving socio-economic and natural environment. However, it is to be well distinguished the features of relatively independent (sub)systems -e.g. while "satisfaction from farming activity" is an important social attribute of agrarian sustainability, the modernization of social infrastructure and services in rural areas is merely a prerequisite (factor) for the long-term sustainability of farms and agrarian sector.

Incorporated internal dynamism of the systems also implies an "end life" (there is no system which is sustainable forever) as a particular agrarian system is considered to be sustainable if it achieves (realizes) its "expected lifespan" (Raman, 2006). For instance, if due to the augmentation of farm households' income the number of subsistence and part-time farms is decreasing while agrarian resources are effectively transferred to other structures, this process should not be associated with a negative change in sustainability. On the other hand, if farms of a particular type and sector are not able to adapt to the dynamic economic, institutional and climate changes through adequate modernization in technology, product, and organization, their sustainability is low.

Characterization of sustainability must also be predictive since it deals with future changes rather than the past and only the present. In addition, sustainability has to be a criterion for guiding changes in policies, and farming and consumption practices, agents' behavior, for focusing of research and development priorities, etc. In that sense, analysis of the levels and factors of "historical" sustainability of farms of certain type and specialization, particular agro-ecosystems or regions, or entire sector ("achieved level of sustainability") are extremely useful for the theory and practice. The assessments of past states help identify critical factors and trends in sustainability of farms and industry, and undertake efficient measures for its improvement by managers, stakeholders, state authority, etc.

Sustainability is to allow facile and rapid diagnostic, and possibility for intervention through identification and prioritizing restrictions, testing hypothesis, and giving possibility for comprehensive assessments. Since most system are difficult to comprehend, calculate, and monitor in everyday activity (Hayati *et al.,* 2010), the later suggests that agrarian sustainability is easy to understand and practical to use by agents without being associated with huge costs.

Agrarian sustainability characterizes the *ability of agriculture to maintain its economic, ecological and social functions in a long-term.* Agriculture "produces" multiple products, "private" and "public" goods (food, rural amenities for hunting, tourism, land scape enjoyment), environmental and cultural services, habitat for wild animals and plants, biodiversity, including less desirable ones such as waste, harmful impacts etc. All these functions of agrarian production are to be taken into account as sustainable agriculture must be economically sustainable, and ecologically sustainable, and socially sustainable.

The evaluation of Bulgarian agrarian sustainability is based on a methodology developed for analysis ofgovernance systemsand sustainability levels in Bulgarianagriculture which is presented in details in our previous publications (Bachev *et al.,* 2017). The system for assessing agrarian sustainability includes properly formulated and selected principles, criteria, indicators and reference values for each of them (Table 1). The principles are the highest level which expresses the state of sustainability within the three major aspects - economic, social and ecological. The criteria are more specific than principles and are related to indicators which express the state of agricultural sector assessed when the relevant principle is realized. The indicators are quantitative and qualitative variables from a different type, for example behavior, business, investment, outcome, impact which can be valued and allow the measurement of correspondence with a criteria, giving idea of sustainability in all its aspects. Reference values are the desired values such as absolute, relative, quality of each of the indicators for specific conditions of Bulgarian agriculture which assist the evaluation and give direction to improve/achieve sustainability (Bachev *et al.,* 2017).

Information for each indicator is gathered from official sources – EUROSTAT, DG Agriculture and rural development, National Statistical Institute, Department "Agrostatistics" at the MAF, Ministry of environment and waters. For some of the indicators expert assessment is used.

Very often individual indicators for each Criteria, Principles and Aspects of sustainability are with unequal number that requires an integration of indicators (Table 1). For the integral assessment of sustainability for every Criterion, Principle, and Aspect, and the Overall level, equal weights are used for each Principle in a particular Aspect, and for each Criterion in a particular Principle, and for each Indicator in a particular Criterion.

Table 1. *Principles, criteria and indicators for assessment of Bulgarian agrarian sustainability at sectoral level*

Principles	Criteria	Indicators	Reference value
		Economic Aspect	
Financial stability	Reducing dependence on subsidies	Share of direct payments in Net Income	EU average level
	Sufficient liquidity	Stocks	EU average level

	Minimizing dependence on external capital	Ratio of assets growth to interest paid	EU average level
Economic effectiveness	Positive or high profitability	Cost - effectiveness	EU average level
		Profitability of capital	EU average level
	Maximize or increase labour productivity	Labour productivity	EU average level
	Maximize or increase land productivity	Productivity of land	EU average level
	Maximize or increase livestock productivity	Livestock productivity	EU average level
	Support or increase of marketed output	Share of imported product in the total agriculturalproduct	EU average level
Competitiveness	Support or increase of sales	GVA change	EU average level
Adaptability to economic environment	Sufficient adaptability to market environment	Ratio of factor income to fixed costs	EU average level
	High investment activity	Growth of long-term assets	EU average level
		Social Aspect	
Welfare of employed in agriculture	Equality of income with other sectors	Ratio of agricultural income to the average income in the country	National economy average level
	Fair distribution of income in agriculture	Variation of payment of hired labour to factor income	National economy average level
	Sufficient satisfaction from farm activity	Variation of employed in agriculture to the entire population	EU average level
	Satisfactory working conditions	Correspondence to official norms	Expert assessment
Conservation of farming	Preservation of the number of family farms	Number of family farms	EU average level
		Share of family labour to all employed	EU average level
		Average age of managers	EU average level
	Increasing the knowledge and skills	Share of trained farmers	EU average level
		Share of the managers with secondary and higher education	EU average level
Gender equality	Equality in men-women relations	Share of female farm managers	Program target
Social capital	Participation in professional associations and initiatives	Share of hired labour members of labour unions	EU average level
	Contribution to the development of regions and communities	Share of farm population in general population	EU average level
Adaptability to the social environment	Sufficient ability to respond to the ceasing farming activity and the demographic crisis	Change in gross fixed capital formation to the change in the number of people employed in agriculture	EU average level
		Ecological Aspect	
Air quality	Maintaining and improving air quality	Reduction of CO2 emissions	Scientific norms
Land quality	Minimizing soil losses	Soil water erosion index	Scientific norms
		Soil wind erosion index	Scientific norms
	Preservation and improvement of soil fertility	Amount of nitrogen fertilization	Scientific norms
		Amount of phosphorus fertilization	Scientific norms
	Maintaining a balanced land use structure	Share of arable land (without fallow) in total agricultural areas	Program targets
	Preservation of landscape features	Amount of area covering the requirements for “green” direct payments through maintaining landscape elements	Program targets
Water quality	Maintaining and improving water quality	Index of groundwater pollution	Scientific norms
Effective energy consumption	Minimizing the use of conventional energy	Fuel consumption per unit area	Scientific norms
Biodiversity	Maintaining or enhancing natural habitats	Change in the number of habitats	Program targets
		Share of agricultural land in NATURA 2000 and other protected areas	Program targets
Animal welfare	Compliance with the principles of animal welfare	Level of compliance with the principles of animal welfare	Program targets
Organic production	Increasing the organic production	Share of areas under conversion or certified for organic production	EU average level
Adaptability to the environment	Sufficient adaptability to climate change	Variation in the yield of main crops	EU average level
		Share of production losses in gross output in livestock sector	EU average level

Source: Bachev *et al.,* 2017.

The Integral Index for a particular Criterion (IS_c), Principle (IS_p), Aspect of sustainability (IS_a) or Overall level (IS_o) is an *arithmetic average of relevant Indicators andIndices:*

$IS_c = \sum IS_i/n$ (n – number of Indicators)

$IS_p = \sum IS_c/n$ (n – number of Criteria)

$IS_a = \sum IS_p/n$ (n – number of Principles)

$ISo = \sum IS_a/3$

On the basis of the indicators value and the reference value for each indicator sustainability score is calculated. The score could fall within one of six groups, presented in Table 2. These groups are applied also for the interpretation of the Integral Sustainability Index.

Table 2. *Limits for grouping of integral assessments of agrarian sustainability*

Sustainability Index	Sustainability level
0,91 - 1	Very High Sustainability
0,71 - 0,90	High Sustainability
0,51 – 0,70	Good Sustainability
0,31 - 0,50	Moderate Sustainability
0,11 - 0,30	Insufficient Sustainability
0 - 0,10	Unsustainable

Source: Governing and Assessment of Agrarian Sustainability - Experiences, Challenges, and Lessons from Bulgaria and China.

The primary level for calculating Integral indexes is the indicator sustainability score determined by the reference values. The reference values for each indicator have two thresholds (binary vector method). Thelower threshold on which the indicator sustainability score is determined 0 (unsustainable) and an upper threshold, where the reference value complied to sustainability score up to 1 set up using the expert judgment, average numbers, trends, scientific norms, etc.

3. Results and discussion

Evaluating the different aspects of the Bulgarian agrarian sustainability is based on the developed methodology and a set of selected indicators. The focus in the research is evaluating the level of sustainability within the three main aspects – economic, social and ecological, and identifying the critical elements. Based on the indicators value within the three aspects an integral sustainability score is also calculated. The integral sustainability index of the Bulgarian agriculture is **0.58**. That means that the Bulgarian Agrarian Sustainability could be defined as *Good*. However there are still a lot of opportunities for improvement in future, because the index is closer to the lower group. That also requires understanding of the factors leading to this result and the respective role of each aspect for the Overall Sustainability of the Bulgarian agriculture.

Every aspect of agrarian sustainability has its principles, criteria and indicators that help calculating the total sustainability level of the Bulgarian agriculture. The value of each indicator on sectoral level was transformed into Sustainability Index. Principles are the highest hierarchical level associated with the multiple functions of agriculture – economic, social and ecological.

Our assessment has found out that the Economic sustainability of the Bulgarian agriculture is *Good* (index of sustainability 0.7). This aspect has been evaluated on the basis of four major principles – Financial stability, Economic effectiveness, Competitiveness and Adaptability. The lowest integral score is for the Economic effectiveness principle – 0.47 (Figure 1). Each of these principles has different criteria and indicators that are used for calculating the sustainability score.

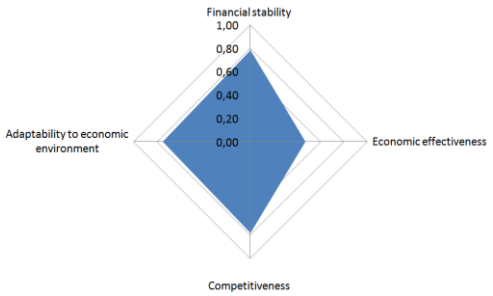

Figure 1. *Indexes of sustainability for the major principles within the Economic aspect of agrarian sustainability*

Source: Own calculations, based on NSI, Agrostatistics department

Twelve indicators are used to calculate the sustainability score of each one of the eleven criteria for the fourprinciples of economic sustainability. Figure 2 presents the sustainability scores of the different indicators. The index of Economic effectiveness sustainability has been calculated on the basis of 5 indicators – *Cost-effectiveness*; *Profitability of capital*; *Labour productivity*; *Productivity of land*; and *Livestock productivity*.

Bulgarian agriculture is characterized by low labour, land and livestock productivity. This is due to different factors. The labour productivity in Bulgaria is lower than the EU average not only in the agriculture, but in the other economic sectors as well. That is due usually to low or old technology use, low labour quality, lack of qualification, lower motivation due to insufficient payment, aging labour force and other socio-economic factors. The labour productivity affects the economic effectiveness, but it is also strongly connected with the social aspects of the agrarian sustainability.

The land productivity of the Bulgarian agriculture is also on unsatisfactory level. The gross output per hectare in Bulgaria for the major arable crops is well below the EU average and it varies from year to year. The sustainability score for the livestock productivity is higher, but it is still only on *Good* level and it needs to be improved in order to ensure higher economic sustainability for the Bulgarian agriculture. Other indicators that show low or only *Moderate* sustainability levels are the Share of direct payments in the net income (0.35) and the Growth of the long termassets (0.50). *Good* is the sustainability score of the GVA change (0.53). These indicators demonstrate the high dependency of the Bulgarian agriculture on government transfers through the direct payments. In case these transfers are decreased or they stop this would affect the financial stability of the Bulgarian agriculture. Insufficientincrease in the GVA of the Bulgarian agriculture and small rate of investment growth affects its long term economic sustainability negatively.

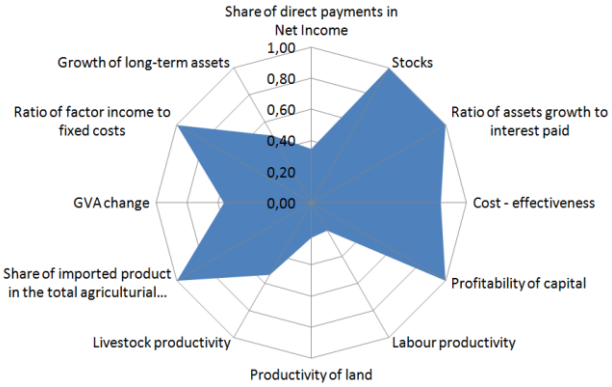

Figure 2. *Indicators of economic sustainability of Bulgarian agriculture*
Source: Own calculations, based on NSI, Agrostatistics department

The Social and Environmental sustainability of the Bulgarian agriculture are assessed as *Good* (the score for both of them is 0.53).Theassessment of the Social aspect of the agrarian sustainability is based on five principles: *Welfare of employed in agriculture; Conservation of farming; Gender equality; Social capital; and Adaptability to the social environment.* Each of these principles is evaluated based on set of criteria and indicators. The lowest level has the sustainability indexfor the *Social capital* principle, the Gender equality principle and the Welfare of the employed in agriculture (Figure 3).

The indicators used to assess the sustainability (Figure 4) of the Welfare of employed in agriculture are: Ratio of agricultural income to the average income in the country; Variation of payment of hired labour to factor income; Variation of employed in agriculture to the entire population; Correspondence to official norms. While there is no big variation of the *Payments of the hired labor to the factor income* (the sustainability score of this indicator is 0.8 which mean

Highsustainability) and *Variation in the number of employed* (0.52 sustainability score which denotes Good sustainability), the other two indicators have low sustainability score - *Ratio of agricultural income to the average income in the country* has a score of only 0.15 and *Correspondence to official norms* – 0.27 that means they have Insufficient sustainability.

Higher sustainability score has the *Conservation of farming* principle, although the *share of trained farms* is very low. It sustainability score is only 0.06. This indicator emphasizes a specific problem that need and should be addressed. More employed in the agriculture should receive training and possibilities to develop their skills and knowledge in order to increase the sustainability of the agricultural sector. One of the problems is that a big percent of the employed are seasonal workers that could not be trained specifically for a certain job or operation.

Figure 3. *Indexes of sustainability for the major principles within the Social aspect of agrarian sustainability in Bulgaria*
Source: Own calculations, based on NSI, Agrostatistics department

Gender inequality is another major issue that Bulgarian agriculture faces and which leads to low score for the *Equality* principle. Based on data of the share of women farm managers the indicator value suggests that there is inequality. The percentage of women on managerial positions is low, as well as the number of women that own agriculture businesses. However, the women are active members of the rural community which could in future increase their decision-making roles.

The highest is the value of the Index of adaptability to the social environment. Having in mind the changing social structure, the decline in the number of employed in agriculture, as well as the demographic crisis in the rural areas, there is a positive trend in the ratio of gross fixed capital formation to labour availability. That means that the shortage of labour could be successfully resolved with more capital formation.

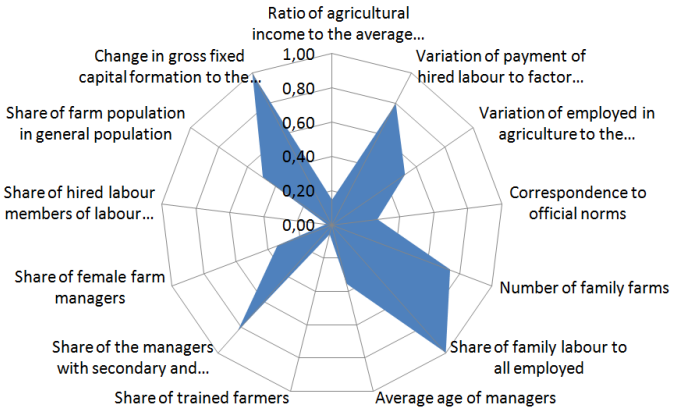

Figure 4. *Indicators of social sustainability of Bulgarian agriculture*
Source: Own calculations, based on NSI, Agrostatistics department

The *Environmental sustainability* of the Bulgarian agriculture is assessed as *Good with a* score of 0.53. This is the aspect with most diverse indicators covering eight principles of environmental sustainability (Figure 6). The highest level of sustainability has been measured for the *Effective energy consumption* (0.77) and the *Adaptability to the environment* (0.74). Concerns stem from the level of the indexes for some of the principles that are critical for ensuring environmental sustainability. Such principles are the *Air quality*, *Biodiversity*, *Animal welfare,* and *Organic production*.

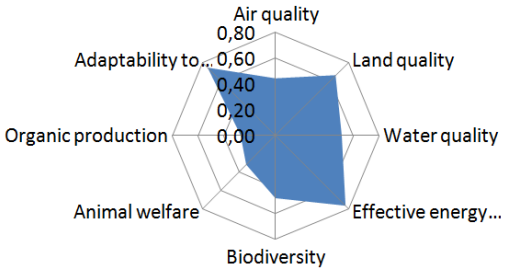

Figure 6. *Indexes of sustainability for the major principles within the Environmental aspect of agrarian sustainability in Bulgaria*
Source: Own calculations, based on NSI, Agrostatistics department, EUROSTAT and reports from MOEW

The role of agriculture for maintaining and improving the air, water and soil quality, and preserving the biodiversity is important, since it has direct effects on the environment and its elements. As evident from the sustainability assessment we have conducted, these areas are also among the critical fields where the public and governmental efforts should be focused.

The individual scores of the different indicators within the ecological aspect of sustainability are also very diverse (Figure 7).The highest sustainability score is calculated for the *Amount of area covering the requirements for "green" direct payments through maintaining landscape elements* (0.84) and the *Soil wind erosion index* (0.81). The high level of compliance of the Bulgarian farmers with the so called "green" requirements could be attributed to the different options they were able to choose from.

The lowest score is for the following indicators: *Change in the number of habitats* (0.24), *Share of areas under conversion or certified for organic production* (0.27), and *Level of compliance with the principles of animal welfare* (0.32).

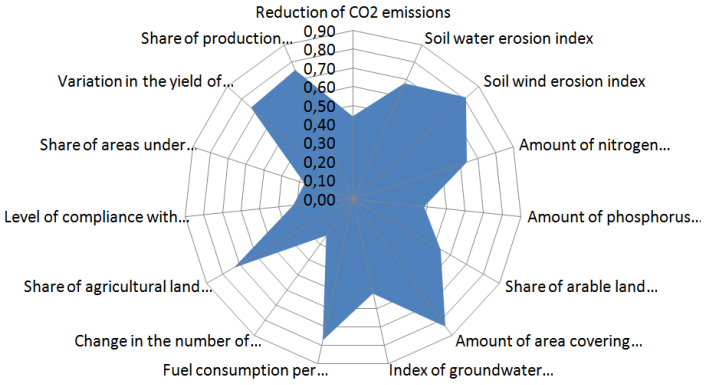

Figure 7. *Indicators of social sustainability of Bulgarian agriculture*
Source: Own calculations, based on NSI, Agrostatistics department, EUROSTAT and reports from MOEW

All this indicators reveal that there is still much work needed in order to ensure that the agriculture does not harm the environment and the biodiversity. It is

important to point out that in several areas the Bulgarian agriculture demonstrates strong sustainability, like the effective energy consumption. It should be made sure that in case of more intensive economic growth these high scoring factors will not deteriorate.

The agrarian sustainability assessment is important for detecting critical areas that should be addressed by the policy makers in Bulgaria. Previous attempts to assess the agriculture on macro-level haven't been made, but on micro-level Bachev (2017) and Bachev (2016) analyzes the level of sustainability of the Bulgarian farms. According to survey with farm managers the economic sustainability is weaker than the environmental and social at farm level. Our sectoral analyzes gives the opposite results - a higher economic sustainability and lower social and ecological. This could be due to several reasons - the different objectives and assessment methodology of studies. While our current assessment is on the sustainability of agriculture, the former study concerns sustainability of diverse farming structures (which is only a part of the sustainability of agrarian sector as a whole). Similarly, datafor this study are at national level, from national statistics and are summarized, while farm level data used in referred publication is from survey with farm managers. It is well-known that the managers of agricultural holdings usually consider their economic situation as more important and often identify ecological and social aspects as secondary and therefore consider that these objectives are easier to achieve. Most of the managers in the survey quote that their activity meets almost all ecological and social requirements.

This discrepancy is also a reason to implement a research at the farm level as part of this research project with the same methodology and indicators used at sectoral level. This will allow for full comparability of the results and will provide a picture of the actual differences in the way micro-and micro-level sustainability is assessed and evaluated in agriculture.

4. Conclusions

The development of coherent and adequate agricultural and food policies require recognizing the main critical areas that influence negatively the development of sustainable and efficient agriculture. Sustainability is a key concept that will have greater importance in the future, having in mind the problems the world population is facing with the climate and all unexpected effects of its change. Agricultural scientists have recognized the importance of sustainable agrarian development, although there is no universally accepted definition and methodology to assess it. This article offers methodology and assessment of the different aspects of the Bulgarian agrarian sustainability in its economic, social and ecological aspects. The overall level of sustainability is *Good* (0.58). All the aspects have been assessed as *Good*, but the sustainability index of the economic aspect (0.70) is significantly higher than the indexes of the social and ecological aspects (both 0.53). There are critical areas within each aspect that require specific measures in order to ensure the sustainable development of the Bulgarian agriculture.

Suggested holistic approach will be further experimented at different (subsectoral, ecosystem, regional, farm) levels, improved and ultimately applied for comparative studies of sustainability levels of Bulgarian and other (Chinese, East European, etc.) agricultures.

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